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RESEARCH NOTE NC-62

NORTH CENTRAL FOREST EXPERIMENT STATION, FOREST SERVICE—U.S. DEPARTMENT OF AGRICULTURE

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EARLY GROWTH OF EASTERN WHITE PINE SEED SOURCES IN THE LAKE STATES

ABSTRACT. — In 5-year-old test plantations in Minnesota, Wisconsin, and Michigan, eastern white pine seedlings from seed sources that are fast-growing in one location are not necessarily fast-growing in other locations. Until more intensive studies of the Lake States seed sources can be made, foresters should confine collection of white pine seed to local stands.

Early results of an eastern white pine seed source study show the need for widespread testing in the search for sources of superior tree seed. In 5-year-old test plantations in Minnesota, Wisconsin, and Michigan it is apparent that seedlings from seed sources that are fast-growing in one location are not necessarily fast-growing in other locations. Until more intensive studies of Lake States seed sources can be carried out, foresters should confine collection of white pine seed to local stands.

This study was started in 1955 by the Northeastern Forest Experiment Station. Cooperators have already reported early results of the growth of the seed sources planted in North Carolina (Sluder 1963), Lower Michigan (Wright *et al* 1963) and the Central States (Funk 1965).

Methods

Seed collected from 17 sources throughout the natural range of the species (table 1) was sown in 1958 in the Toumey Nursery in Watersmeet, Michigan. In the spring of 1960 the 2-0 stock was transplanted to the Hugo Sauer Nursery near Rhinelander, Wisconsin. The four test plantings reported here were established with the 2-2 stock in 1962 at Cass Lake, Minnesota; Wabeno, Wisconsin; Manistique, Michigan; and Pine River, Michigan. The plantings are laid out in a randomized complete block design with 24 replicates of 1-tree plots.

Nursery Results

The five fastest growing seed sources at the end of the first year in the nursery were from Tennessee, Lower Michigan, southern Wisconsin, Georgia, and Nova Scotia (table 2). The slowest growing sources were from Minnesota, Maine, Upper Michigan, and Pennsylvania.

The same height growth pattern was also noted at the end of the second growing season in the nursery.

By the end of the fourth growing season in the nursery the Lower Michigan, southern Wisconsin, and Tennessee sources were still among the fastest growing, but the local northern Wisconsin source and an Ontario source had moved into the top five (table 2). The Nova Scotia and Georgia sources dropped below average.

Table 1. — *Location of eastern white pine seed sources*

Source number[1]	Location of origin	Lat.	Long.	Mean Jan. temp[2]
		°N	°W	°F
1650 (28)	Lake County, Minn.	48.0	91.8	9
1622 (19)	Cass County, Minn.	47.4	94.5	6
1629	Washington County, Minn.	45.2	92.8	11
1623 (18)	Forest County, Wis.	45.9	88.9	11
1651 (31)	Sauk County, Wis.	43.5	90.0	17
1624 (15)	Allamakee County, Iowa	43.3	91.3	16
1656 (29)	Houghton County, Mich.	47.1	88.7	14
1670 (33)	Newaygo County, Mich.	43.5	85.7	22
1636 (25)	Algoma District, Ontario	46.2	82.6	10
1635 (23)	Pontiac, Quebec	47.5	77.0	1
1637 (20)	Luneburg, Nova Scotia	44.4	64.6	26
1638 (14)	Penobscot, Maine	44.0	68.6	20
1639 (12)	Franklin County, N.Y.	44.4	73.4	15
1640 (6)	Monroe County, Penn.	41.1	75.4	25
1632 (16)	Ashland County, Ohio	40.8	82.3	29
1634 (3)	Greene County, Tenn.	36.0	82.8	36
1633 (1)	Union County, Georgia	34.8	84.1	39

1/ Numbers in parentheses are numbers assigned by the Northeastern Forest Experiment Station.

2/ U.S. data interpolated from maps in "Climate and Man." U.S. Dep. Agr. 1941 Yearbook. Canadian data from Canadian Meteorological Division Climatic Summaries.

In the first winter following transplanting in the Hugo Sauer Nursery, seed sources differed in winter injury, which showed up as needle browning and discolored terminal buds. As might be expected, the trees from the Tennessee and Georgia sources showed the greatest incidence of injury (table 2). The source from Nova Scotia — a maritime climate source — showed less damage than the southern Appalachian sources but distinctly more damage than any of the other sources. The six sources showing the most winter injury were all from areas where the mean January temperature exceeds 20°F. Of the remaining 11 sources, 10 were from areas where the mean January temperature is less than 18°F.

Plantation Results

There are differences between plantations and between seed sources in mortality 5 years after planting (table 3). Plantation mortality ranged from 11 to 18 percent, with the highest mortality occurring in the plantations with the lowest mean January temperature. Mortality by seed source over all plantings ranged from 6 to 33 percent. There tended to be a relationship between seed source mortality and seed source winter injury as measured in the nursery. The six sources showing the highest winter injury (table 2) were all included in the ten highest mortality sources. There is no obvious reason why the other two high-mortality sources (from Ontario and Minnesota) survived so poorly.

The mean height of the plantations 5 years after field planting ranged from 51 centimeters at Pine River, Michigan, to 87 centimeters at Manistique, Michigan (table 3). Only in the tallest planting, Manistique, were no significant differences found between seed sources.

No source or group of sources was consistently best in all four Lake States plantings. Source 1634 from Tennessee was the tallest in Lower Michigan, but was never better than the fourteenth tallest in the other three plantings. Source 1636 from Ontario was tallest in Minnesota but was only thirteenth tallest in Lower Michigan. The best overall sources (both of which were from only slightly south of the plantations) were from Sauk County, Wis. (1651), and Newaygo County, Mich. (1670). The poorest source was from Nova Scotia.

Table 2. — *Summary of data of eastern white pine seedlings and transplants in the Toumey and Hugo Sauer Nurseries*

Source number	Location	Height above cotyledons[1] 1958 1-0 stock	Height above cotyledons[1] 1959 2-0 stock	Winter injury[2] 1960 2-1 stock	Height[3] 1961 2-2 stock
		Mm	Mm	Percent	Cm
1650	Minnesota	7.2	36	7	13
1622	Minnesota	6.2	28	4	13
1629	Minnesota	7.6	31	6	14
1623	Wisconsin	7.5	34	2	19
1651	Wisconsin	8.4	37	4	17
1624	Iowa	7.0	32	4	15
1656	Michigan	6.3	26	4	13
1670	Michigan	8.9	38	17	19
1636	Ontario	7.6	36	7	17
1635	Quebec	8.1	35	2	12
1637	Nova Scotia	8.1	40	32	15
1638	Maine	6.3	25	17	15
1639	New York	7.1	35	5	16
1640	Pennsylvania	6.9	28	17	15
1632	Ohio	7.6	32	3	15
1634	Tennessee	9.1	42	82	16
1633	Georgia	8.3	38	79	13
Mean		7.5	33.7	17.1	15.1
$S_{\bar{x}}$		0.36	2.62	2.74	.79
Seed source F-value		6.00 *	3.42 *	84.46 *	5.74 *

1/ Measured to the nearest millimeter.
2/ Percentage of all trees showing damage symptoms. Damage scored as present or absent for each tree.
3/ Measured to the nearest 2.5 millimeters.
* Differences among means significant at .05 level.

The three southern Appalachian sources (1633, 1634, and 1640) include the two tallest at Pine River, Mich., the three tallest in southern Lower Michigan (Wright *et al.* 1963), the three tallest in the Central States (Iowa, Illinois, Indiana, Ohio, and Kentucky) (Funk 1965), and the three tallest in North Carolina (Sluder 1963). But none of these three sources is in the tallest five in the Wisconsin and Minnesota plantings.

Moreover, comparing the ranking of the 12 sources common to this study, the Central States study, and the North Carolina study (3-year results), one finds that the ranking at Pine River, Mich., more closely resembles the Central States and North Carolina plantings than do either the Wisconsin or Minnesota plantings.

The data show effectively no change in seed source ranking northward from North Carolina until one passes north and west of Lower Michigan. Then in a relatively short distance (Pine River, Mich. to Wabeno, Wis.) the relative growth rate of the seed sources changes sharply. This emphasizes that generalizations regarding growth rate based on test plantations located within a limited area should not be extended beyond that area.

Only one significant correlation was found between nursery heights and plantation heights; the 1-0 growth was correlated with the 1966 heights in the Pine River, Mich., planting ($r = .55$ with 15 degrees of freedom).

Thus, the sources from milder climates show the fastest growth rate in protected nursery beds but then lose their superiority when exposed to severe winters. These faster growing sources then regain their superiority only when moved back into milder climatic regions.

Table 3. — *Mortality in 1966 and total height in the test plantations*

Source number	Location	Percent mortality, all plantings	Height--seed source mean as a percent of plantation mean[1/]			
			Cass Lake, Minn.	Wabeno, Wis.	Manistique, Mich.	Pine River, Mich.
1650	Minnesota	9	107	103	97	83
1622	Minnesota	10	109	97	97	89
1629	Minnesota	22	110	107	111	111
1623	Wisconsin	13	106	114	97	99
1651	Wisconsin	6	119	124	110	102
1624	Iowa	13	102	112	98	102
1656	Michigan	10	89	93	101	80
1670	Michigan	12	115	108	114	109
1636	Ontario	25	120	103	106	89
1635	Quebec	10	115	98	90	88
1637	Nova Scotia	17	74	77	86	98
1638	Maine	18	89	78	96	90
1639	New York	10	88	113	102	102
1640	Pennsylvania	16	96	94	98	117
1632	Ohio	10	95	119	108	113
1634	Tennessee	19	75	78	88	123
1633	Georgia	33	76	75	99	108
Mortality, percent:						
	Mean	15	18	17	13	11
	$S_{\bar{x}}$	0.74	--	--	--	--
Height, centimeters:						
	Mean		69.6	58.6	86.7	51.3
	$S_{\bar{x}}$		5.84	4.66	5.87	3.66
Seed source F-value		4.95 *	3.32 *	4.48 *	1.43	2.95 *

1/ Height was measured to the nearest centimeter.
* Differences among means significant at .05 level.

Seed Collection Recommendations

The growth differences among the Lake States seed sources indicate that we cannot be satisfied to collect seed from any white pine stand in this area. Instead, many stands must be tested to locate enough superior sources of seed for reforestation in the Lake States.

For the more severe climates of Minnesota, Wisconsin, and Upper Michigan we should obtain and test seed from stands in areas where the mean January temperature is less than 20°F. This would include white pine stands in all of Minnesota, Wisconsin, and Upper Michigan and the northern parts of Lower Michigan and Ontario.

For planting in southern and western Lower Michigan, seed sources from the southern Appalachians offer enough promise to warrant further investigation.

In the meantime foresters in the Lake States would be well-advised to use seed from stands no more than 100 miles from the planting site.

Literature Cited

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